2.0 Overview

Performance Measuring

Introduction

Performance measures are an important topic. People are pursuing excellence and are eager for results to show their efforts are working. Having data is fundamental, and the old saying, "without data, you're just another person with an opinion," has its wisdom. Still, the use of performance measures is not as easy as it appears, and poor use can do more harm than good.

The following introduction is taken from “Grassroots Approach to Statistical Methods” and is reprinted with the permission of R. S. (Bud) Leete, Lockheed Martin Energy Systems.

Why Do We Measure?

Measuring is the act of assigning numbers to properties or characteristics. We measure to quantify a situation, to regulate, or to understand what affects things we see. Sometimes we measure with gauges and instruments; sometimes, we simply count things. Performance measures can help you understand and improve performance. It is exciting to measure, to benchmark, and to stretch to do better.

Some Measures are More Direct than Others

A first step in deciding what to measure is to decide what you want to improve. Sometimes there is a direct measure. For example, runners or swimmers who want to improve their performance in a 100-yard race can measure their times directly as a performance measure. In golf, measuring performance by the score shot may seem appropriate. However, it is important to note that the golfer's score is not as direct a performance measure as the swimmer's time, because factors like course difficulty and playing conditions vary considerably. In tennis or figure skating, it is even harder to arrive at a performance measure.

Similar difficulties arise at work. Suppose we want to improve morale. Surveys are a possibility. We could ask people, "how is your morale?" and administer a survey periodically. The answer is subjective, and people may tire of being asked this question periodically, especially if morale does not improve. Eventually, we might devise a measure that is indirect, but easier to obtain, like attendance. "If morale is high, people will come to work," will be our logic. A performance indicator is born. Of course, other factors influence attendance, such as sickness, family situations, births, deaths, and the weather.

It is important, therefore, that performance measures be as direct as possible. To improve attendance, measure attendance. To improve cycle times, measure cycle times. If you want to improve morale, you may be better off deciding how to improve morale and measuring your efforts.

Rule 1: The more directly you can measure, the better.

Operational Definitions

Once you decide what to measure, carefully and thoughtfully determine how to take your measurement. Likewise, if you are counting you need to know exactly what you should and should not count. This is the process of setting operational definitions.

As an example, suppose you want to measure the level of beryllium in a work area as an industrial safety performance measure. You'll be taking smear samples. Should you check places at random? Should you instruct the technicians to look for the "worst" places or at "typical" places? Should you select a set of specific places and check those same places each measuring period? Should you average the values? What measuring method should be used in the laboratory? Should the lab perform duplicate analyses and average them?

Questions like these are important to the long-range success of the indicator. Efforts to standardize and communicate instructions are needed. Operational definitions are instructions and turn general terms, such as "contamination" or "scrap," into specific actions, procedures, and computations. Without them, we leave ourselves vulnerable to variations people will introduce in interpreting incomplete instructions.

Rule 2: Define exactly how to collect the data for the indicator and how to make the computation. Then, make sure everyone understands.

How Defined is the Underlying Process?

There are two types of studies: "enumerative" and "analytical" studies. Enumerative studies are those that show how things are but have no value in predicting. Taking a census is an enumerative study. Measuring corn yield is an enumerative process. The farming conditions of 1984 or 1987 or whenever are gone forever. They will never be repeated. In this sense, there is no consistent underlying process. Analytical studies are used to study a process and show what that process is capable of doing in the future unless something changes that process.

Dr. Walter Shewhart, a pioneer in statistical process control, said a process consists of equipment, methods, materials, and people being blended to produce output in some environment. For example, in farming, the environment is at times so dominant that the measure of yield may reveal little of the farmer's processing methods, the quality of the soil, or seeds.

SECTION 2: DATA TOOLS

2.0 OVERVIEW

In developing a performance measure, flowchart the process that produces the result you will measure. If you can, you'll be able to use the performance measure as a tool for improving. If you can't, the road to improving will be winding, at best.

Rule 3: If you can't flowchart the process you want to improve, a performance measure will offer little insight into what you should do to improve.

Interpreting What You See

Variation is a fact of life. What we want to do with performance measures is to understand the variation. We want to learn how to influence performance with elements of the process that we can control. To interpret what we see, we need to know about variation and how observations vary. We need to understand statistical methods.

Rule 4: Use the numbers to help people improve, not to judge people.

Statistical Models of a Process

Mathematicians have studied physical phenomena for years to understand and model how things work. Consequently, statistical methods have been developed that everyone working with performance measures should understand. Two main aspects of statistical methods deal with statistical distributions and statistical control.

It is important for leaders, whether they be leaders of a company or key members of a team, to understand statistical concepts on variation, including statistical distributions and statistical control. They should also understand special causes, common causes, and control charting. In addition, they should clearly understand the concept of "tampering" with a process.

Rule 5: Learn to understand variation. You'll be more effective.

Types of Variation

One way of visualizing variation is through a demonstration. Dr. W. Edwards Deming, often called the father of modern statistics, wrote of a funnel experiment that helps explain variation. This experiment requires a funnel, a marble, a stand to hold the funnel steady, a flat place to work, and paper and pencil. On a level space, we arrange the funnel and its stand. We mark a spot on our paper as the "target" and position the stand so we can drop the marble through the funnel and land it on the target. The "process" consists of taking the marble, dropping it in a swirling motion into the funnel, and letting it land on the paper. We use the pencil to mark where the marble comes to rest. Marking lets us see the pattern of variation.

When the pattern of variation is observed after 30 or so drops one can see how the pencil marks on the paper tend to form a natural pattern. This is the pattern of variation. The funnel, all set up for the workers to use, is the "system." Workers perform the operations in the system. They are given the funnel, the marble, and the procedures to follow. Managers are responsible for the system. If a change is required in funnel height, or composition, in the marble composition or diameter, or in the flatness of the table, the change can only be made by managers. The local workers are those who work inside the system but don't have the authority to change it. Managers are the workers who have the authority to make changes to the system.

This natural pattern of variation shows what the process is capable of doing. When the marble process continues to run, the pattern becomes predictable. We don't know where the next marble will fall, but we can expect the pattern to be preserved. If it is not preserved, we look for a special cause.

A key concept is that we must study the pattern of variation. If it is controlled, meaning observations fall seemingly at random within some overall natural pattern, then the process is performing at its natural capability. It is a management responsibility to improve a controlled process. If it is uncontrolled or unstable, meaning the observations fall in patterns that seem to defy the laws of probability, then special causes of variation are present. The local workers ought to be able to identify these special causes because of their closeness to the process.

Rule 6: Only management can improve a controlled process.

Tampering

When people don't understand variation, many things can happen: (1) trends are identified when there are no trends, (2) trends are not identified when there are trends, (3) employees blame or credit others for things over which others have no control, (4) past performance can't be understood, and (5) future plans can't be made.

Any time you see common cause variation and make a process adjustment to correct for this variation, you increase the variation in your process. You make it worse. Adjusting a process when you should not is called "tampering." Consider a process operator who works at a control station, monitoring the moisture content of a powder being processed. Every 15 minutes, he samples the powder. If it is below 5.4 percent, he turns a knob to raise the moisture content. If it is above 5.4 percent, he lowers the moisture content. He sounds like a conscientious worker. In truth, he is unnecessarily adding variation to the process. Likewise, for a manager or supervisor to react to normal process variation and expect explanations or corrective actions is wasteful. "Last month there were six instances of machine breakdowns. This month there were eight. Why are breakdowns up 25 percent?"

Rule 7: Ignorance of variation is not bliss. It increases variation.

2.0 OVERVIEW

The Use of Goals

Goals encourage us and challenge us to act. Worthwhile goals are to stay in business, to provide jobs, to reduce costs, to communicate more with customers, to better understand our processes, and to promote teamwork. In our excitement to meet our goals, we must remember tampering.

Suppose someone sets a goal that "we will not have more than 20 off-quality pieces in any month." Typical actions that might come from this are: (1) soliciting reasons why some months have more than 20 off-quality reasons, (2) comparing data on months with more than 20 off-quality pieces to the data on the "good" months, (3) having celebrations for months where the goal is met, and (4) taking disciplinary action on workers who produce off-quality work or on supervisors when goals are missed. While the intention of producing less off-quality work is good, any of these actions can be harmful. They can lead to fear, cover-up of off-quality work, and breakdown of teamwork. Those who understand variation could show that this process is a controlled process, operating at a level that is obviously unsatisfactory to those wishing it were better. Rule 6 tells us that management must improve the underlying system.

Rule 8: We insist on driver's education for those who want to drive; we should insist on statistical education for those who want to set goals for others.

Statistical Methods of Looking at Performance Measures

What are the signals to look for in process data? How do we spot unusual variation in a performance measure? There are several tests to use. Using statistical methods, control charts can be developed. When control limits are computed and charted the probabilities of a value exceeding the control limits are remote. Thus, values that fall outside the control limits are considered signals of special causes and must be investigated.

Good performance measures are also assessed using statistical methods for run charts. When the results are plotted, values are observed in relation to the center (median) line. Eight consecutive points above or eight consecutive points below the center line signal the presence of a special cause causing a shift in level. Six consecutive points, each of which larger (or each of which is smaller) than its preceding point, are the statistical signal of a trend.

When signals of special causes are identified, the local workers need to be involved. When no signals of special causes exist, the process is operating at its best. Dr. Deming wrote that workers are not trained until they produce output in statistical control. Once the output is in statistical control, the process is performing to its natural limits and can be improved only by system improvements, which is a management function.

Rule 9: We learn when a curious person sees an unusual event and acts.

A Performance Measure Illustration

Figure 2.1 shows a performance measure that Baldrige Award Examiners use as a model. While they are not prescriptive to suggest that we should be measuring the percent of shipments on time, the style is one to copy because it: (1) has significance to the organization; (2) shows trend data for a significant period of time; and (3) shows benchmark results from other organizations.

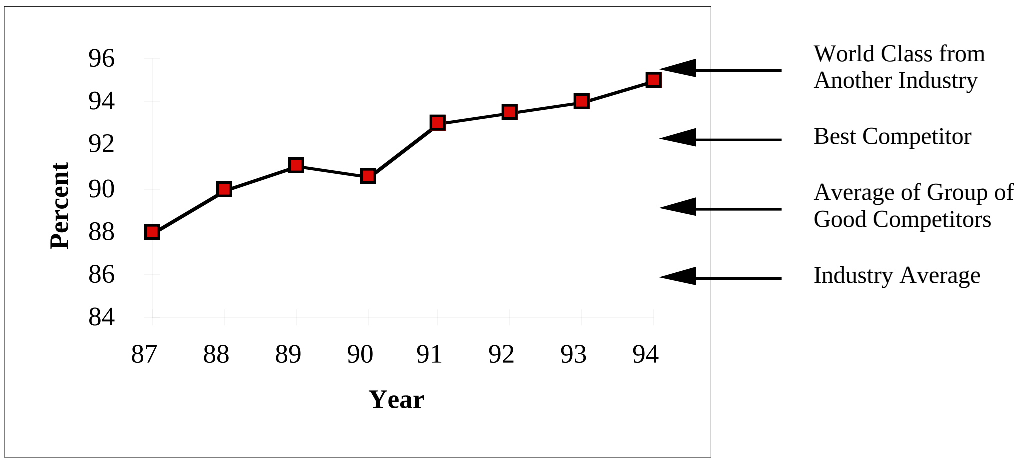

Figure 2.1
Percent of Shipments on Time for Product Line A

Note also that while the summary is given on a year-by-year basis as an organizational measure, there are supporting monthly results that can be assessed and studied for special causes.

Summary

Performance measures focus attention on data. There have been successes where merely the calling of attention to expected results produced improvement. However, some methods of using data to bring about improvement are more successful than others. Teamwork, cooperation, and openness are assets to an organization working to improve. As Ralph Stayer of Johnsonville Sausage said, “Everyone wants to excel. Everyone wants to be part of a winning team.” Too much zeal for results and accountability can lead to tampering and exactly the opposite effect we wish to produce.

Few situations in the business world are entirely black and white. Education is required. Organizations need to decide what measures they need to be competitive and work to establish processes and systems that produce the desired results. The use of statistical methods is important. So is the knowledge of how to work with and learn from others.